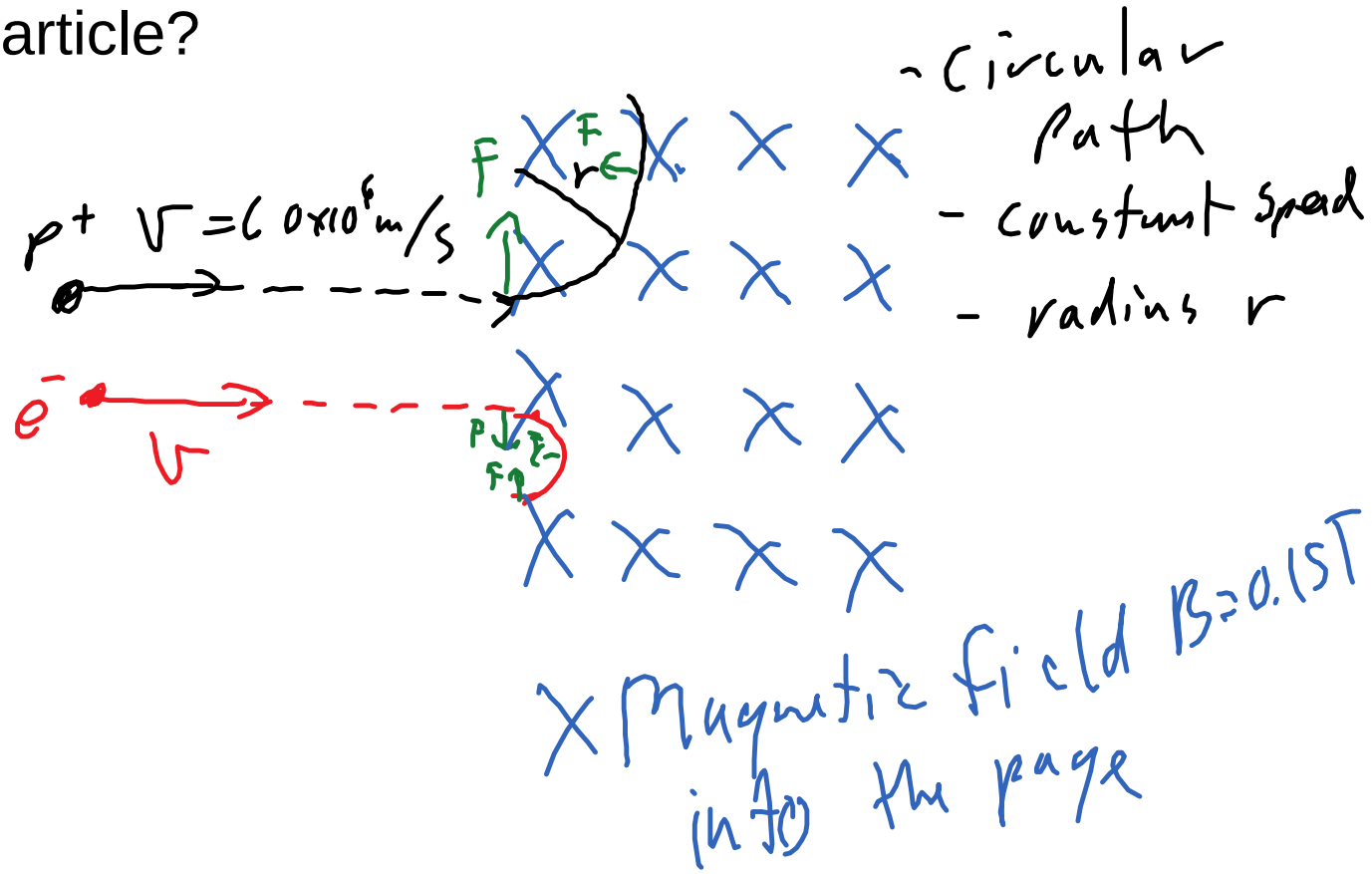
Eg. A proton and an electron are accelerated to 6.0 x 10^6 m/s before going into a 0.15T magnetic field.

a) What is the direction of the force on each particle?



b) What is the magnitude of the force on each particle?

Both particles experience the same force because they have the same charge, v and B

F=BIL=qvB (assuming v is perpendicular to B)

$F=1.602x10^{-19}C(6.0x10^6m/s)(0.15T)$

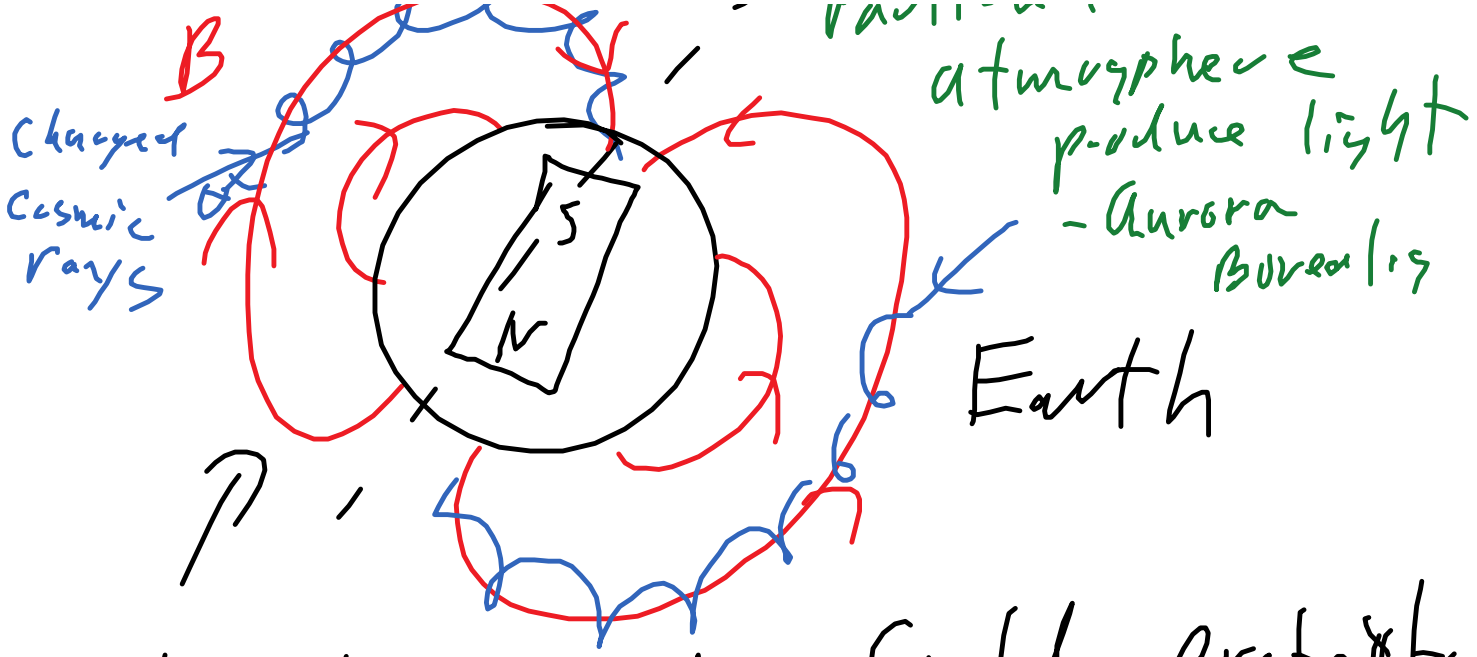
$= 1.442 \times 10^{-13}$ N = 1.4×10^{-13}N on both

c) What is the acceleration on each particle?
a=F/m
Proton = $1.442 \times 10^{-13}N / 1.67 \times 10^{-27}kg$
$= 8.634 \times 10^{13} m/s^2$
Electron $= 1.442 \times 10^{-13}N / 9.11 \times 10^{-31}kg$
$1.58 \times 10^{17} m/s^2$

d) What is the radius of the circular path for each?
$F_c = F_B$
$mv^2/r = qvB$
$r = mv/qB =$
Proton r= $(1.67 \times 10^{-27}kg \times 6.0 \times 10^{6} m/s) /$
$(1.602 \times 10^{-19}C 0.15T)$
0.42m
Electron r = 0.23mm

e) What if the particles are movign parallel to the B field? - there is no force.

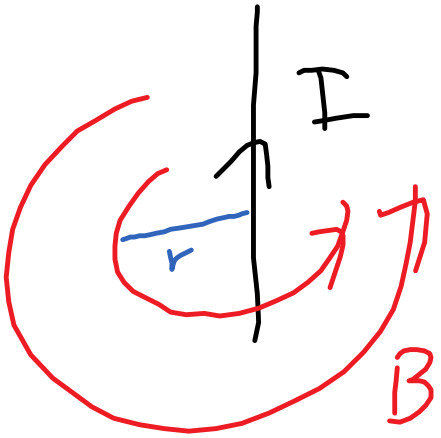
f) What if the particle velocity is at angle θ to B field?
The component of v perpendicular to B ($\sin\theta$) is the value you use to calculate the force.
The path will look like:
A spiral - circular perpendicular to the field, constant v parallel to the field.

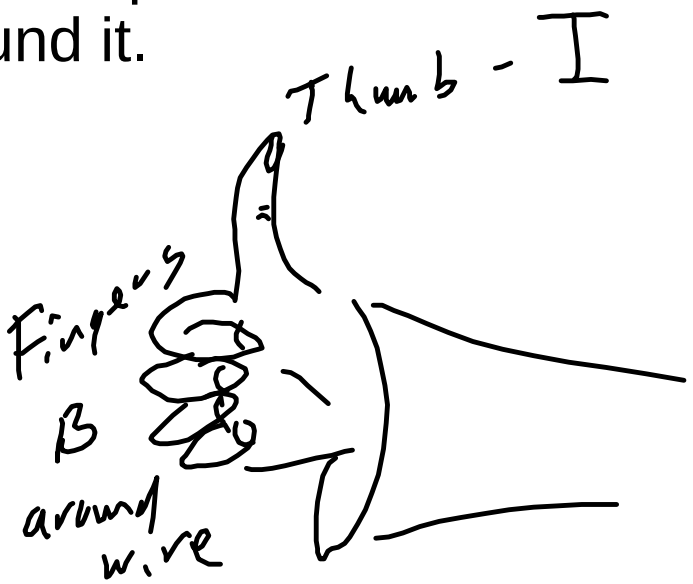


Earth's magnetic field protects us from charged cosmic rays.

Two more right hand rules:

1. A current carrying wire produces a magnetic field around it.





$$B = \frac{\mu_0 I}{\quad}$$

$2\pi r$

r is perpendicular distance from wire, in m.

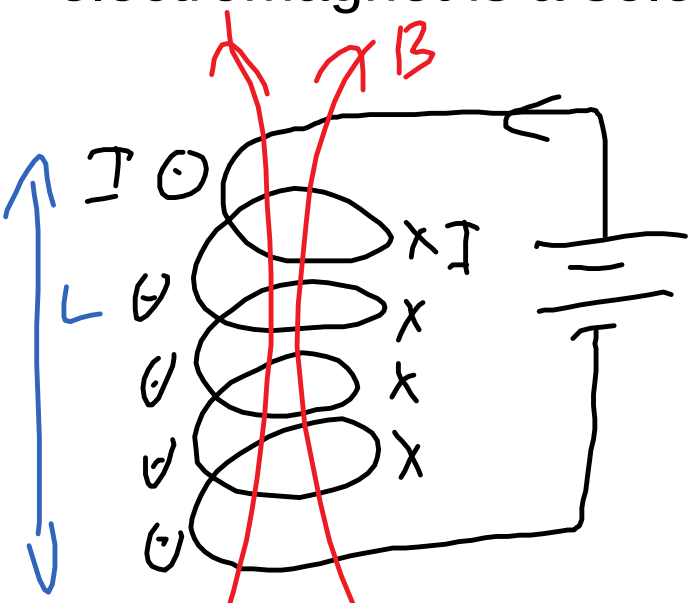
I is current, in A.

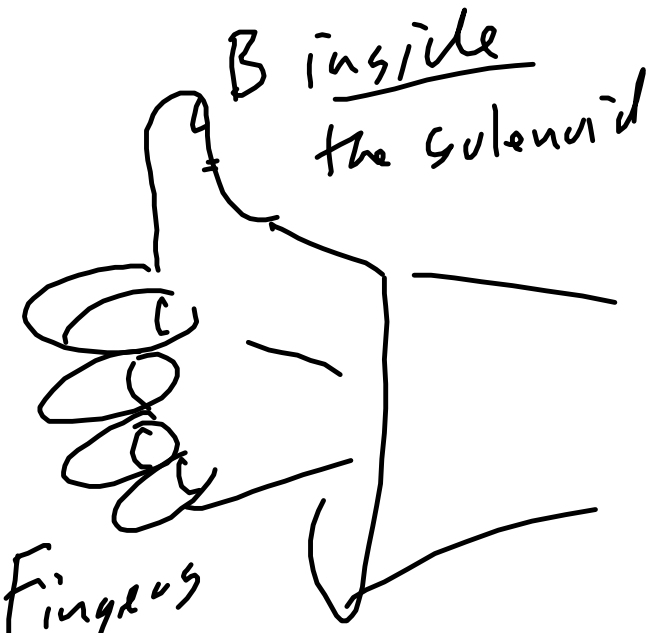
B is magnetic field strength, in T

μ_0 is a constant
- Permeability of free space.

$= 4\pi \times 10^{-7} \frac{Tm}{A}$

Last right hand rule:
Solenoid is coils of wire with a current produces a stronger magnetic field. An electromagnet is a solenoid.





Fingers

I

$$B = \mu_0 \frac{N}{L} I$$

N is number of turns (Coils) of the Solenoid.

L is the length of the Solenoid.